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Synthesis of Cubes of Poly (Methyl Methacrylate) to Through of Room Temperature and Microwave Process

KEYWORDS: Poly(methyl methacrylate),microwave, Atomic Force Microscopy

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ABSTRACT *In this research cubes Poly (methyl methacrylate (PMMA) were synthesized by controlled curing temperature and by use of the microwave technique. The cubes were analyzed using atomic force microscopy and impact tests. The results cubes show that differ in pore size and surface. Such materials can be used for applications in areas of clinical dentistry as making prosthesis, allowing differentiate physical characteristics related to the quality of material on clinical grounds related to retention of food and microorganisms, fragility related to the amount and size of pores, dehydration and related breaking strength of the material.*

INTRODUCTION

The synthesis of various biomaterials for applications in clinical medicine and dental restorations, have undergone significant development and a great interest of many researchers, this is the event in which various methodologies have been developed for manufacturing technique known as microwave. The use of various acrylics like PMMA has been of great interest in the synthesis of materials for use in clinical dentistry. In this context, some researchers as Daniela Maffei et al. They have used the technique of microwave curing as the acrylic resins in Acron ™ MC to measure cure time and porosity (D & Maffei et al 2004). Likewise, other researchers as A Perez et al. compared thermosetting acrylic processes without microwave and microwave for measuring pressure of making dentures (A. Perez Martinez Bustillos H. & L. (2007). Other studies by Fabricio Ogligari & al. show the synthesis of acrylic by the microwave polymerization process to measure the flexural strength methacrylate (Ogliari F & al. 2004). In addition also studied the effect of microwave technique on the stability of resins excelling advantages as the curing time and costs synthesis resins (Paul H, & al. 2007). Other studies have used the microwave technique to produce hybrid materials

with PMMA and guar gum (guar gum) optimizing the processing of these materials (Mishra S, & Sen, G, 2011). In this context the PMMA has been studied in the presence of graphene sheets using microwave irradiation results in higher PMMA morphology and thermal stability (MA A & al. 2013).

MATERIALS AND METHODS

Cubing PMMA

For the synthesis of cubes Poly (methyl methacrylate), four different brands of acrylic dentures bases were used, ProBase, Opti-Cryl, Nic-tone and EZ Cryl, which were mixed in proportions of 3:1 (polymer-monomer), then proceeds to perform the process curing follows: in a first step 20 wax cubes 12 x 12 x 35 were used in total mm (5 cubes per sample PMMA) Hiflex mark, in a second step, 3 cubes PMMA ($C5O2H8$) n were placed in high temperature metallic muffles, containing a first hub ProBase brand PMMA, a second bucket containing brand PMMA Opti-Cryl, and third mark cube containing PMMA, Nic-tone, the fourth acrylic cube corresponding to EZ Cryl, this flask was placed in a ceramic and fiberglass was applied and the microwave technique. Subsequently to the dewaxing process ProBase cubes, Opti-Cryl and Nic-tone, metallic muffles placed and immersed in water at 100 ° C for 5 min to create spaces in the molding chamber 12 x 12 x 35 mm. Then to achieve unwaxing the bucket with PMMA EZ Cryl, is subjected to high temperature for two minutes to achieve a primary dewaxing, the highest percentage of wax is removed with a spoon, and a damp cotton is placed for another 2 minutes for cotton absorb remaining wax. After removing the wax casting chambers of different trademarks, acrylic plaster separator is placed nic tone mark to favor the separation of acrylic plaster muffle. For phase acrylated acrylics ProBase, Opti-Cryl and Nic-tone, were subjected to a pressure of 1500 psi and placed in a bowl of water at 25°C, then gradually increasing the temperature to 100°C, then the temperature is lowered to below the boiling point (95° - 98°C) and held for about 4 hours to complete curing acrylics. Subsequent to curing the microwave technique fourth cube containing PMMA mark EZ Cryl this is coated with plaster of Paris type II alpha, it is then subjected to a pressure of 1500 psi and 120 volts at a frequency of 2450 megahertz for 4 minutes with a muffle ceramic fiberglass Emerson mark.

Finally, the cubes were removed from the flask to be analyzed by atomic force microscope (AFM) and analysis of impact tests.

RESULTS

Figure 1 PMMA synthesized cubes, columns 1,2 and 3, are presented ProBase cubes, Opti-Cryl and Nic-tone respectively formed by heat curing at room temperature, column 4 is can be seen the bucket corresponding to acrylic PMMA (EZ Cryl) and was developed by the microwave technique.

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Figure1: acrylic cubes 1) ProBase, 2) Opticryl 3) Nictone and 4) Ez Cryl.

The cubes were analyzed using impact tests and the results obtained correspond to an impact resistance of 28 lbs cubes as shown in Table 1. 28 lbs 28 lbs 28 lbs

Sample 1	Sample 2	Sample 3	Sample 4
ProBase,	Opticryl	Nictone	Ez Cryl
28 lbs	28 lbs	28 lbs	28 lbs

Table 1. Impact test: 1) ProBase, 2) Opticryl 3) Nictone 4) Ez Cryl.

In this test all showed acrylic similarity in behavior, however, that the analysis through atomic microscopy, the results show the following differences in the roughness and porosity size acrylics. In Figure 2, the image of atomic force microscopy, acrylic ProBase observed (bucket # 1), which has a surface with valleys of a length of 4.0 nm, a height of 20 nm and a width of 2.90 nm, presence of pores is observed with a size of between 5 and 50 nm. Bucket # 2 corresponding to the acrylic Opticryl, has a roughened surface with valleys of a length of 3.0 nm, a width of 265 and a height of 4.0 nm respectively, can be observed the presence of pores with a size between 4.8 nm and 260 nm, bucket # 3 represents acrylic Nictone with a rough surface containing valleys with a length of 13 nm, a width 12 and a height of 4.5 nm respectively, the presence of pores is observed with a size of 1.9 to 3.5 nm finally the cube # 4 which corresponds to acrylic Ez Cryl and was synthesized by microwave technique has a rough surface on which you can see a lot of valleys with a length of 4.7 wide valley of 4.5 and a height of approximately 1.5 nm, the presence of pores is observed with a size from 0.2 to 1 nm respectively. The difference in pore size between the acrylic ProBase, Opticryl, Nictone and Ez Cryl is because by means of the microwave technique was decreased as the polymerization time and a reduction in the appearance of pores because electromagnetic waves caused by heating acrylic residues, achieve a uniform distribution polymerization process, this causes the formed acrylic interpenetrating molecular networks that contribute to decreasing pore size and the pressure in the process synthesis whereby there is a marked difference with other techniques reported in the literature. Furthermore, the results found in acrylic thermoset by conventional techniques, can be observed irregularities on its surface and pore sizes would represent a disadvantage in clinical applications because it may be a greater increase in the accumulation of food residues, bacteria and filtration problems.

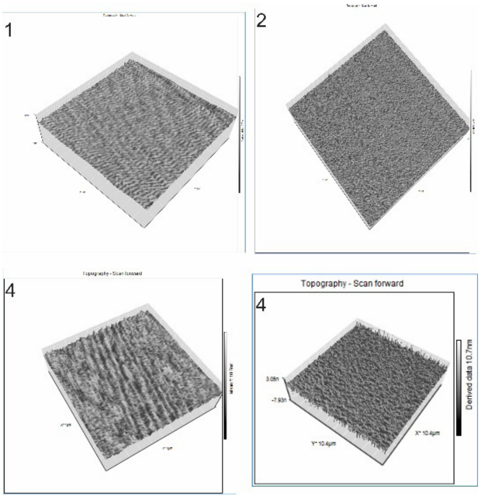

Figure 2: Image of atomic force microscopy. 1) ProBase, 2) Opticryl 3) Nictone and 4) Ez Cryl.

CONCLUSIONS

The use of PMMA in this work shows that acrylics can be synthesized with a capacity of impact resistance and decreased pore size. By means of the microwave technique achieved an easy route to carry out the polymerization of the polymer chains resulting in a decrease in cure time, homogeneity in the acrylic surface and smaller pores sizes present in acrylic cubes compared to conventionally thermoset acrylics. Similarly to synthesize acrylic microwave technique several events should be considered: (a) union of the chains of PMMA with the monomer during the polymerization process; (B) formation of interpenetrating networks; (C) uniform heat penetration due to electromagnetic waves; and (d) acrylics recovery after curing. Through this technique it is possible to study various aspects of the biological function of acrylics on which patients would apply prosthetic materials. Atomic Force Microscopy is a tool that can be used to study the structure of metal precursors such as PMMA.

Further studies are currently undergoing analysis are (i) the effect of heat by microwaves on the percentage of residual monomer, and (ii) the effect of the concentration of the polymer-monomer ratio on curing times and reduced pore molecular and atomic level.

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